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SURFACE PANEL OF SPORTS BALL AND ITS MANUFACTURE
[Kyo-giyo- bo-ru no hyo-men' paneru oyobi sono seizo- ho-ho-]

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SPECIFICATION /1*

1. Title

Surface Panel of Sports Ball and its Manufacture

2. Claims

(1) In a sports ball which is furnished with a hollow, spherical and elastic tube unit or a ball base body, which is made by adding a reinforcing layer to the tube, and multiple sheets of a surface panel which are attached to the entire surface of the ball base body, the surface panel of a sports ball is characterized by the fact that the surface panel is composed of a panel main body which consists of a thermoplastic elastomer, a printed layer which is adhered to the surface of the panel main body, a protective layer which consists of a transparent resin harder than the main body and is adhered so as to cover the surface of the main body and the printed layer, and a transparent covering layer which consists of a low friction coefficient material and is formed over the protective layer.

(2) The surface panel of a sports ball as described in Claim 1 is characterized by the fact that the thermoplastic elastomer consists of one thermoplastic elastomer selected from a group of polyvinyl chloride thermoplastic elastomer, polyester thermoplastic elastomer, urethane thermoplastic elastomer, olefin thermoplastic elastomer and styrene thermoplastic elastomer, that the hard resin consists of an acrylic resin or a urethane resin, and that the low friction coefficient material consists of wax.

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* Numbers in the margin indicate pagination in the foreign text.

(3) A manufacturing method of a surface panel of a sports ball is characterized by the fact that it is a manufacturing method of a surface panel, multiple sheets of which are adhered onto the surface of a sports ball, and that it is constituted of a process to place a transfer leaf, which is formed by laminating in this order of a mold releasing layer which contains a low friction coefficient material, a protective layer consisting of a transparent hard resin, a printed layer containing a dye and an adhesive layer on a polyethylene terephthalate film substrate, into a metallic mold with a cavity which has a shape of the surface panel, and a process in which the heated and softened thermoplastic elastomer is poured into the cavity and the printed layer is adhered to the surface of the molded surface panel through the adhesive layer, while the protective layer and the covering layer containing a low friction coefficient material are formed on the entire surface of the surface panel including the printed layer.

(4) The manufacturing method of the surface panel of sports ball as described in Claim 3 is characterized by the fact that the thermoplastic elastomer consists of one thermoplastic elastomer which is selected from a group of polyvinyl chloride thermoplastic elastomer, polyester thermoplastic eslatomer, urethane thermoplastic elastomer, olefin thermoplastic elastomer and styrene thermoplastic elastomer, that the hard resin consists of an acrylic resin or a urethane resin, and that the low friction coefficient material consists of wax. /2

(5) The manufacturing method of the surface panel of a sports ball as described in Claim 4 is characterized by the fact that the printed

layer in the transfer leaf is formed by the photogravure printing.

3. Detailed Explanation of the Invention

<Field of Industrial Application>

This invention pertains to the surface panel of a sports ball and its manufacturing method.

<Prior Art>

In the past, for a sports ball such as a soccer ball which is constituted by hermetically sealing air, it was commonly constituted by adhering hexagonal or pentagonal panels of a cut natural or synthetic leather onto its surface. In this type of sports ball, the periphery of the panel was usually thinned so that a groove was formed between the adjacent panels when attached to the ball, improving the ball grip and flying distance, etc. As a device which automatically performs this type of thinning process of the panel's periphery (commonly called a "Coba (edge) skinning process"), there is a constitution disclosed in Kokai S58-58399. Also, there is Kokai S45-9619 which discloses a transferred mark for printing onto a panel; as a device to mold the ball's outer layer by the injection molding method, there is a constitution disclosed in Kokai S49-26068.

<Problem(s) that the Invention is to Solve>

When the surface panel of a sports ball is molded using the established techniques, there are the following problems.

(a) When a panel for a soccer ball is composed of, for example, a polyvinyl chloride thermoplastic elastomer by an injection molding method, the surface's friction coefficient is too high making it unsuitable to be

the surface panel of a ball. Incidentally, the friction coefficient of the polyvinyl chloride thermoplastic elastomer is between about 0.92 and 1.00; the friction coefficient suitable for a ball (soccer ball) is between about 0.40 and 0.45. For the measurement of the friction coefficient, it was measured referring to ASTM D-1894-78.

(b) The panel molded as mentioned above is poor in both moldability and dimensional stability; the molded panel is often disfigured into a wavy form. Since this type of panel is soft (about 60 to 65 in hardness) and thin (about 1 to 3mm), the warp generated inside appears on the surface as a change in shape.

(c) The panel made of polyvinyl chloride thermoplastic elastomer molded by the injection molding method lacks gloss and compares poorly with the existing ball made of natural or synthetic leather.

(d) When the polyvinyl chloride thermoplastic resin is injected into the metallic mold's cavity, there are problems such that a plasticizer or the like contained in the polyvinyl chloride evaporates and solidifies as it is cooled down, adhering to the surface of the metallic mold; hence, while repeating the molding, the adhered amount increases, resulting in repeating the shaving of the entire surface of the metallic mold's cavity. This sort of treatment is normally performed every several months to a half year.

This invention solves all of these problems, and realizes the most suitable panel as a surface material of sports balls and its manufacturing method.

<Means to Solve the Problem(s)>

For the first invention, in a sports ball, which is furnished with a hollow, spherical and elastic tube unit or a ball base body which is formed by adding a reinforcing layer to the tube, and multiple sheets of a surface panel attached to the entire surface of the ball base body, the surface panel of the sports ball is composed of a panel main body which consists of a thermoplastic elastomer, a printed layer adhered to the surface of the panel main body, a protective layer consisting of a transparent resin which is harder than the main body and is attached to cover the surface of the main body and the printed layer, and a transparent covering layer which consists of a low friction material and is formed over the protective layer.

This second invention is a manufacturing method of the surface /3
panel, multiple sheets of which are adhered to the surface of a sports ball, which is constituted by a process to place a transfer leaf, which is composed by laminating in this order a mold releasing layer which contains a low friction coefficient material, a protective layer consisting of a transparent hard resin, a printed layer containing a dye and an adhesive layer onto a polyethylene terephthalate film substrate, into a metallic mold with a cavity shaped into the form of the surface panel; and a process in which the heated and softened thermoplastic elastomer is poured into the cavity and the printed layer is adhered to the surface of the molded surface panel through the adhesive layer, while the protective layer and the covering layer containing a low friction coefficient material are formed on the entire surface of the surface panel including the printed layer.

<Operation>

The surface panel in this invention is constituted of a panel main body consisting of a thermoplastic elastomer, a printed layer which is adhered to the surface of the panel main body, a protective layer consisting of a transparent resin which is harder than the panel main body and is adhered so as to cover the surface of the panel main body and the printed layer, and a transparent covering layer which consists of a low friction coefficient material and is formed on the protective layer. The protective layer functions to give strength to the soft panel main body and to add a feel similar to that of synthetic leather to it. Also, the protective layer functions to slightly harden the entire surface panel, making its handling easier at the time of adhering to the ball base body. The covering layer functions to lower the friction coefficient of the panel, providing the optimum friction coefficient (from about 0.40 to 0.45) as the ball surface skin. Also, the covering layer, since it generates a moderate gloss, functions to provide a surface condition similar to that of natural or synthetic leather.

<Exemplary Embodiments>

Figures 1 and 2 depict a soccer ball 1 as an exemplary sports ball; on its surface, the surface panels 2, i.e. 12 sheets of pentagonal panels and 20 sheets of hexagonal panels are arranged and adhered so as to come into contact with the respective circumferences. The circumference of the surface panel 2 is thinned down with an inclination. Hence, at the joined part of the surface panels 2, a groove 3 is formed. 4 represents a concave part of a prescribed pattern such as figures, symbols and letters,

etc. which are formed on the surface of the surface panel 2; in this concave part 4, the printed layer 5 is formed. 6 represents numerous projected bodies which are formed at a prescribed interval on the back surface of the surface panel 2 for increasing the flexibility of the surface panel 2 and making it lightweight. The surface panel 2 is constituted of a panel main body 7 which consists of a polyvinyl chloride thermoplastic elastomer with a hardness (JIS) of about 60 to 85; a protective layer 8 which consists of an acrylic resin with a higher hardness than that of the panel main body 7, for example poly methyl methacrylate and which is adhered to the surface of the panel main body 7; and a covering layer 9 which contains a low friction coefficient material such as wax or the like. As the polyvinyl chloride thermoplastic elastomer material which forms the panel main body 7, Sumiflex (registered trademark) or Sumikon (registered trademark) (both are manufactured by Sumitomo Bakelite K. K.), Sanprene (registered trademark) (manufactured by Mitsubishi Kasei K. K.), Aron elastomer AE (registered trademark) or Aron NP (registered trademark) (both are manufactured by Toa Gosei Kagaku Kogyo K. K.) can be used. The thickness of the panel main body 7 is about 1mm to 3mm; the total thickness of the protective layer 8 and the covering layer 9 is about 2μ to 10μ. The quantity of lubricant which is mixed into the polyvinyl chloride thermoplastic elastomer which comprises the panel main body 7 in order to improve the adhesive property to the ball base body is set to be the minimum quantity. 10 represents a rubber inner lining layer to which the surface panel 2 is adhered. 11 represents a thread winding reinforcement layer; 12 represents a rubber tube in which the

air is hermetically sealed so as to have a prescribed internal pressure. In this tube 12, the air is injected through a valve not shown in the figure. The ball base body is constituted of the respective parts mentioned above. For the ball base body, it is possible to use a tube unit which consists of a thermoplastic elastomer with a reinforcing function, for example Hightrel (registered trademark).

Figure 3 depicts the cross section of the transfer leaf 13 which performs the printing onto the surface panel 2. 14 represents a substrate which is made of a 35 to 50μ thick polyethylene terephthalate film; 15 represents an about 1μ thick mold releasing layer which is attached to the substrate 14; a low friction coefficient material consisting of wax is added to an acrylic resin; its tukon hardness is about 22. 8 represents the said approximately 1μ to 10μ thick protective layer, which is formed on the mold releasing layer 15 and has an approximately 18 to 19 tukon hardness. 5 represents an approximately 40μ thick printed layer, which is formed into a prescribed pattern such as figures, symbols and /4 letters, etc. on the protective layer 8 and contains a dye of a prescribed color, for example black. For this printed layer 5, one formed by a photogravure printing method is suitable. In concrete, a triple layer formed by layering three 1.5μ single printed layers, i.e. one formed by printing three times over to form a layer of about 4.5μ in thickness, is suitable. The printed layer 5 formed by the photogravure printing has such a merit that because of its strong cohesive strength, it is hardly exfoliated after being printed onto the surface panel 2. On the other hand, there is a silk screen method used for printing onto this type of

transfer leaf. Since this has such a shortcoming that the printed layer is easily exfoliated, it is not suitable for printing on the surface panel of a ball. 17 represents an adhesive layer which is formed so as to cover the printed layer 5 and the protective layer 8; for this, a urethane heat sensitive adhesive can be used.

Next, the molding and simultaneous printing of the surface panel 2 using the transfer leaf 13 is explained.

As shown in Figure 4, a pair of metallic molds 19, 20 with a cavity 18 with the shape of the surface panel 2 are prepared. On the other hand, on the metallic mold 20, an injection opening 21 is formed. The metallic molds 19, 20 are in the separated state; the transfer leaf 13 is placed between both metallic molds 19, 20. At this time, the substrate 14 of the transfer leaf 13 is positioned at the side of the interior surface of the cavity 18 of the metallic mold 19. On the cavity 18, a convex part 22 corresponding to the printed part is formed; the printed layer 5 of the transfer leaf 13 is facing the convex part 22. Also, the interior of the cavity 18 of the metallic mold 19 is treated by a microscopically uneven graining process.

Then, the pair of metallic molds 19, 20 are placed one upon another and clamped; a nozzle 23 is fitted to the injection opening 21 and a thermoplastic elastomer 24 which was softened by heating at about 200°C is injected into the cavity 18. By this injection pressure, the transfer leaf 13 is pressed and stuck against the interior surface of the cavity 18 of the metallic mold 19; the printed layer 5 is adhered to the molded panel main body 7 through the adhesive layer 17. After the molding, the

metallic molds 19, 20 are separated; the surface panel 2 is taken out. Onto the surface of the surface panel 2, the protective layer 8 and a portion of the mold releasing layer 15 are adhered so as to cover the printed layer 5, forming the covering layer 9. When molding the panel 2, since the transfer leaf 13 is extremely thin, the microscopic unevenness formed on the surface of the cavity 18 of the metallic mold 19 appears as is on the surface of the surface panel 2. Consequently, the surface panel 2 is treated by the graining process, forming a leather pattern.

On the surface panel 2 thus formed, as shown in Figure 6, a dye of the printed layer 5 passes through the adhesive layer 17 and penetrates into the panel main body 7, forming a colored area 25 on the panel main body 7. The depth of this colored area reached to about 0.3mm in about 10 days after the molding. Also, the penetrating direction converged to the lower direction in the figure, showing a tendency that the penetration into the lateral direction is little. This means that the printing stain is small and is significant to this invention. For the polyvinyl chloride elastomer used to make the dye to penetrate, Sumikon (registered trademark) PMT 2900 (manufactured by Sumitomo Bakelite K. K.) was used; for the transfer leaf, a transfer leaf manufactured by Reiko K. K. was used.

The surface panel 2 thus formed is adhered onto the surface of the ball base body with an adhesive, creating the ball as a finished product.

Figure 7 depicts the friction coefficient characteristics, which are the results of the measurement method based on ASTM D1894-78. The curved line A shows the friction coefficients of the surface panel 2

pertaining to the exemplary embodiment of this invention or the surface of the protective layer 16 of the surface panel 2 which is constituted of the panel main body 7 consisting of a polyvinyl chloride thermoplastic elastomer and a protective layer 16 consisting of a poly methyl methacrylate. The curved line B is shown as comparative example and represents the friction coefficient of the surface panel which is constituted of only the panel main body 7. Moreover, the curved line C represents the friction coefficient characteristics on the surface of the synthetic leather. According to the figure, it is found that for the curved line B, the friction coefficients ranges from about 0.40 to 0.45; this is almost equivalent to that of the synthetic leather; also the curved line B ranges from about 0.92 to 1.00.

In the exemplary embodiment, an example in which a polyvinyl chloride thermoplastic elastomer is used for the panel main body 7 is explained; other than this, it is possible to use a polyester thermoplastic elastomer, for example Hightrel (registered trademark)(manufactured by Tore Dupon K. K.) or Pelprene (registered trademark) (manufactured by Toyo Boseki K. K.); a urethane thermoplastic elastomer, for example Pandex /5 (registered trademark) (manufactured by Dai Nippon Inki Kagaku Kogyo K. K.) or Elastran (registered trademark) (manufactured by Nihon Erasutoran K. K.); an olefin thermoplastic elastormer, for example Sumitomo TPE (Sumitomo Kagaku Kogyo K. K.) or Milastomer (registered trademark) (manufactured by Mitsui Sekiyu Kagaku Kogyo K. K.); a styrene thermoplastic elastomer, for example Toughprene (registered trademark) (manufactured by Asahi Kasei Kogyo K. K.) or Solprene-T (registered trademark)

(manufactured by Nihon Elastomer K. K.). On these materials, proper levels of friction coefficient and durability were obtained. It is also possible to make one with a feel closer to natural leather by mixing finely ground natural leather into the thermoplastic elastomer mentioned above. Also, as the material for the protective layer 8, in addition to the acrylic resin, a urethane resin which has an excellent abrasion resistance can be used.

<Effects of the Invention>

According to this invention, the following effects are obtained.

(a) According to the first invention, on the surface of the panel main body, since a covering layer containing a low friction coefficient material is formed, the friction coefficient of the panel surface is reduced, making it possible to obtain the optimum friction coefficient as a sports ball. That is, for the panel main body, in order to improve the adhesion strength to the ball base body, the mixing of the lubricant is limited to the minimum; hence, its friction coefficient is about 0.95 and high, making this unsuitable as a sports ball as is. Hence, by forming a covering layer containing a low friction coefficient material on the surface of the panel, the friction coefficient of the panel surface is reduced to about 0.40, making it resemble that of a natural or synthetic leather.

(b) According to the second invention, the transfer leaf is placed in the metallic mold cavity; the polyethylene terephthalate film substrate is adhered closely to the microscopically uneven surface in the cavity, making the molding material come into contact with the transfer leaf; therefore, in comparison with a case in which the molding material comes

into direct contact with the surface of the metallic mold, a polyethylene terephthalate with glossier surface can be obtained, making it possible to add the gloss to the surface of the surface panel.

(c) It was confirmed that by placing the said transfer leaf in the cavity, the contraction coefficient of the thermoplastic elastomer can be made uniform; the fluidity of the thermoplastic elastomer is improved, reducing the internal warp and making it difficult to generate the deformity.

(d) The inclined thin part of the surface panel's periphery can be formed into a desired shape so as to coincide with the shape of the molding metallic mold, making the complicated Coba edge thinning device, which was required in the past, unnecessary.

(e) According to the fifth invention, the printed layer is formed by the photogravure printing method, making it possible to provide a printed layer which is hard to exfoliate. This is most suitable for printing the surface panel of a sports ball to which intense impact and friction force are applied.

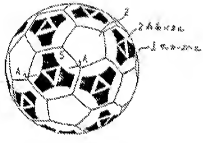
4. Brief Explanation of the Figures

Figure 1 is the front view depicting the surface configuration of a soccer ball. Figure 2 is a cross section cut along Line A-A shown in Figure 1. Figure 3 is a cross section of a transfer leaf. Figures 4 and 5 are cross sections depicting a metallic mold. Figure 6 is a cross section depicting the major parts of the surface panel. Figure 7 is a characteristic chart depicting the friction efficient.

1 ... Soccer ball; 2 ... Surface panel; 5 ... Printed layer; 6 ... Projected body; 7 ... Panel main body; 9 ... Covering layer; 13 ... Transfer leaf;

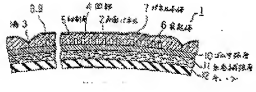
14 ... Substrate; 15 ... Mold releasing layer; 16 ... Protective layer; 18 ... Cavity; 19, 20 ... Metallic mold

[Figure 1] /6



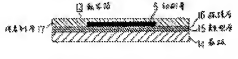
Key: 1)Soccer ball; 2)Surface panel

[Figure 2]



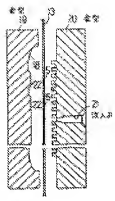
Key: 2)Surface panel; 3)Groove; 4)Concave part; 5)Printed layer; 6)Projected body; 7)Panel main body; 10)Rubber inner lining layer; 11)Thread winding reinforcement layer; 12)Tube

[Figure 3]



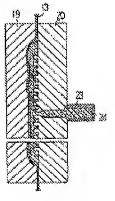
Key: 5)Printed layer; 13)Transfer leaf; 14)Substrate; 15)Mold releasing layer; 16)Protective layer; 17)Adhesive layer

[Figure 4]

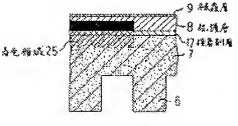


Key: 19)Metallic mold; 20)Metallic mold; 21)Injection opening

[Figure 5]

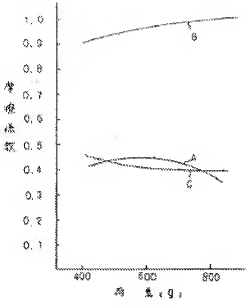


[Figure 6]



Key: 8)Protective layer; 9)Covering layer; 17)Adhesive layer; 25)Colored area

[Figure 7]



Key: x-axis)Load (g); y-axis)Friction coefficient